

# **LOUISIANA DEPARTMENT OF WILDLIFE & FISHERIES**



## **OFFICE OF FISHERIES INLAND FISHERIES DIVISION**

### **PART VI -B**

#### **WATERBODY MANAGEMENT PLAN SERIES**

#### **LOWER PONTCHARTRAIN SUB-BASIN**

#### **CAERNARVON - DELACROIX / BAYOU BIENVENUE CENTRAL WETLANDS UNIT**

#### **WATERBODY EVALUATION & RECOMMENDATIONS**

# **CHRONOLOGY**

DOCUMENT SCHEDULED TO BE UPDATED ANNUALLY

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# WATERBODY EVALUATION

## STRATEGY STATEMENT

### Recreational

Sportfish species such as largemouth bass (LMB) are managed to maintain a sustainable population while providing anglers the opportunity to catch or harvest adequate numbers of fish to maintain angler interest and efforts.

### Commercial

Commercial species are managed with statewide regulations for maximum sustainable yield.

### Species of Special Concern

Species of special concern are managed to protect the current population and to provide an opportunity for recovery to a sustainable population.

## EXISTING HARVEST REGULATIONS

### Recreational

Statewide regulations for all fish species. Recreational fishing regulations may be viewed at this link: <http://www.wlf.louisiana.gov/fishing/regulations>

### Commercial

Statewide regulations apply. Commercial fishing regulations may be viewed at this link: <http://www.wlf.louisiana.gov/fishing/regulations>

### Species of Special Concern

The taking or harassment of any threatened or endangered species is a violation of state and federal law and includes the Gulf sturgeon (*Acipenser oxyrinchus desotoi*).

## SPECIES EVALUATION

### Recreational

Historically, Inland Fisheries' monitoring efforts have been confined to the Caernarvon outfall area and not the greater Lower Pontchartrain Sub-Basin (LPSB). Prior to 2015, all references contained in this section refer to the Caernarvon outfall area of the LPSB. Subsequently, samples and analysis after 2015 in the greater LPSB are divided into two management units: the Caernarvon / Delacroix and the Bayou Bienvenue Central Wetlands units.

### *Largemouth Bass*

LMB are utilized as an indicator species for the overall fish population due to their trophic position. Electrofishing has proven to be the most effective method for collecting warmwater freshwater fishes and is used to evaluate LMB relative abundance (catch per unit effort = CPUE) and size distribution. Standardized electrofishing samples have been collected in the Caernarvon outfall area by Inland Fisheries District 8 for routine LMB population monitoring

in the spring and fall since 1992. A summary of electrofishing samples collected within the Lower Pontchartrain Sub-Basin (LPSB) is found in LPSB MP-A.

#### Largemouth bass relative abundance, size distribution and relative weight

##### Caernarvon / Delacroix

The length distributions for largemouth bass collected from the Caernarvon outfall area in the spring and fall of 2009-2013 are presented in Figure 1. The LMB ranged from 3 to 18 inches total length (TL) with bi-modal peaks at 6 and 12 inches TL. A similar trend is prominent in the Barataria Basin which displays many of the same characteristic as the LPSB. The most recent length distributions for LMB collected in the Caernarvon / Delacroix area from the expanded sampling regime for the spring and fall of 2015 are presented in Figures 2 and 3, respectively. The LMB ranged from 5 to 14 inches total length (TL) in the spring and 3 to 17 inches TL in the fall. Young-of-the-year (YOY) LMB (<7 inches) represent 67% of the fall sample indicating adequate recruitment. Mean relative weight (Wr) of LMB sampled in the fall of 2015 is in the acceptable range (i.e., above a value of 80) in the Caernarvon / Delacroix. Wr is the ratio of a fish's weight to the weight of a "standard" fish of the same length. The index is calculated by dividing the weight of a fish by the standard weight for its length, and multiplying the quotient by 100. LMB mean relative weights below 80 may indicate a potential problem with forage availability. Full analysis of forage and species assemblages is in the Forage and Fish Assemblage section of this document

##### Bayou Bienvenue Central Wetlands

Recent length distributions for LMB collected in the Bayou Bienvenue Central Wetlands for the spring and fall of 2015 are presented in Figures 4 and 5, respectively. The LMB ranged from 4 to 15 inches total length (TL) in the spring and 5 to 17 inches TL in the fall. Mean relative weight (Wr) of LMB sampled in the fall of 2015 is in the acceptable range (i.e., above 80) in the Bayou Bienvenue Central Wetlands Unit.

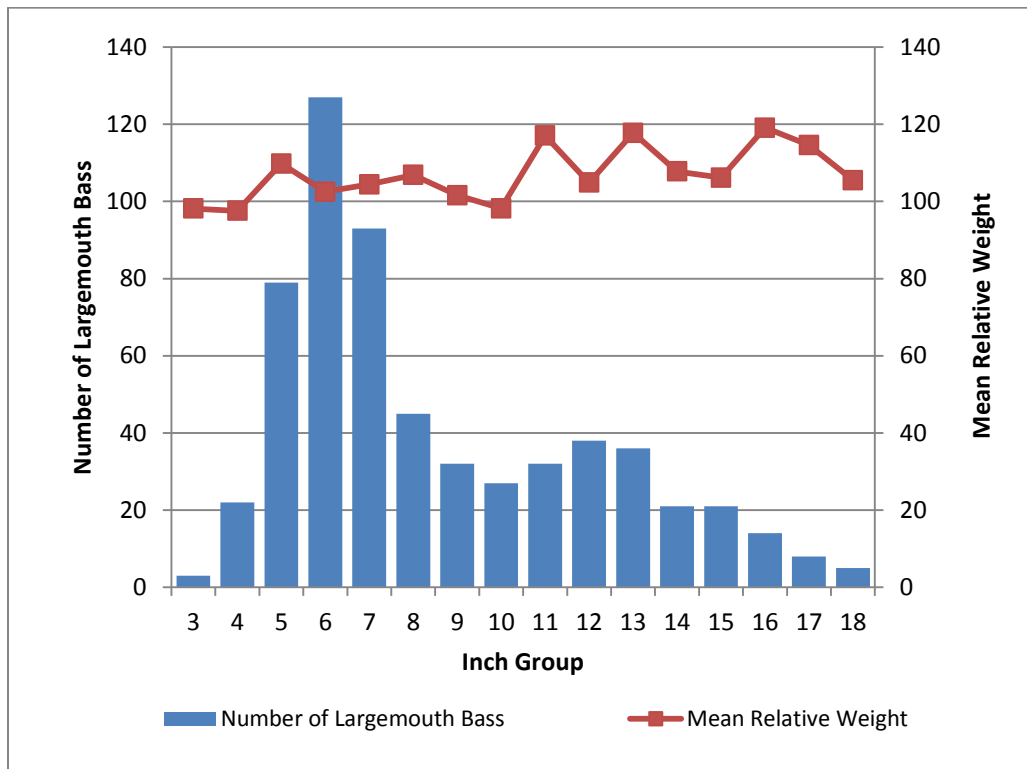


Figure 1. The size distribution by inch group of LMB collected from the Carnarvon outfall area from 2009-2013. Wr calculated from fish collected during fall electrofishing samples.

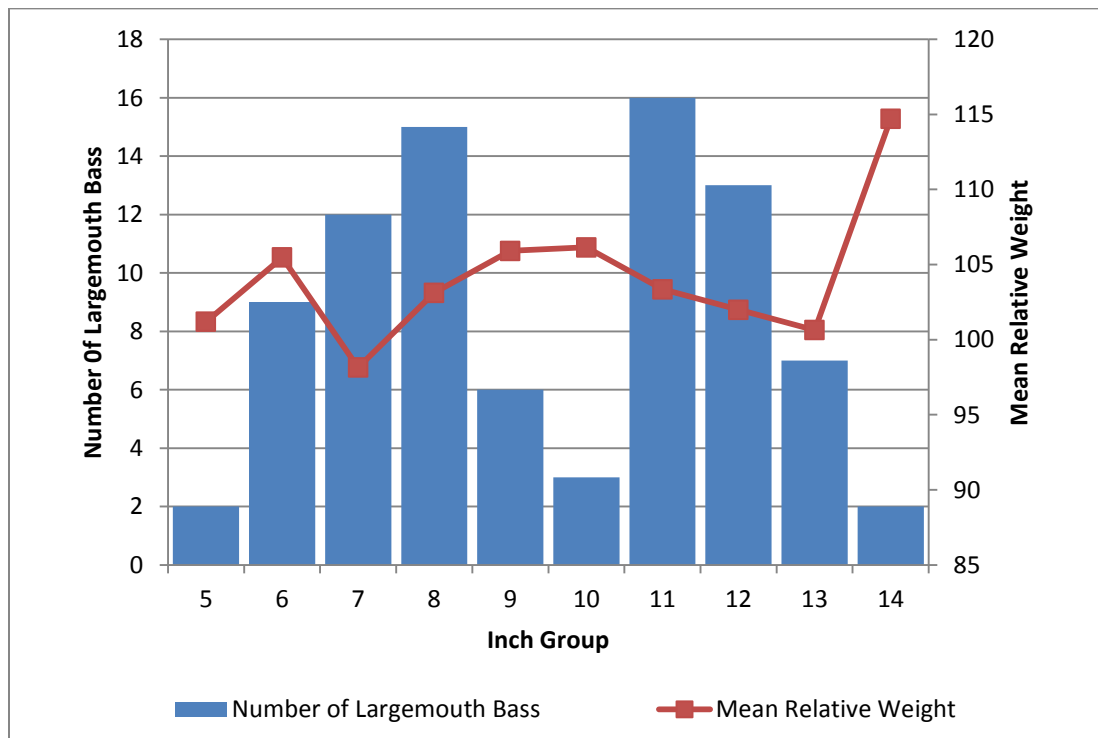


Figure 2. The size distribution and mean relative weight (Wr) by inch group of LMB collected in the spring 2015 from the Caernarvon / Delacroix area. n=85.

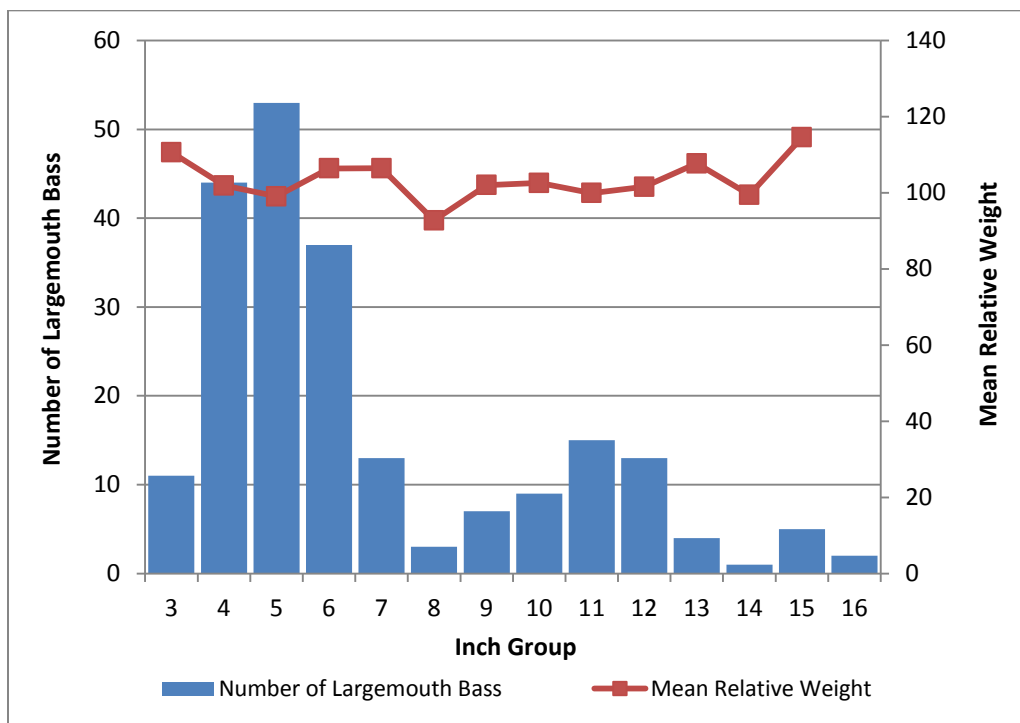


Figure 3. The size distribution and mean relative weight (Wr) by inch group of LMB collected in the fall 2015 from the Caernarvon / Delacroix area. n=217

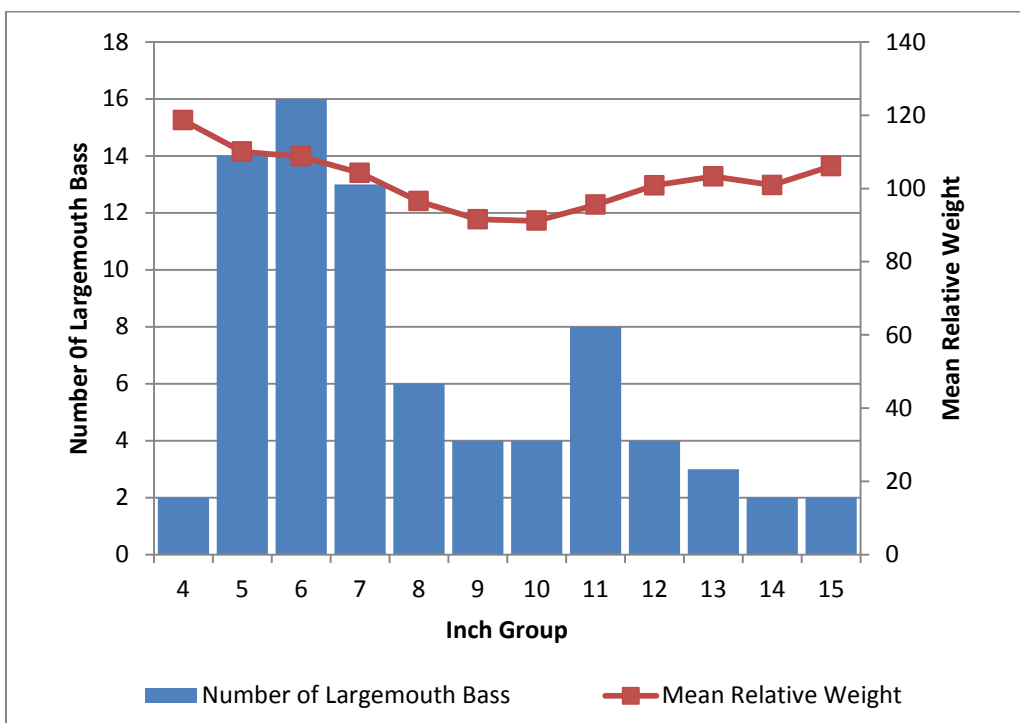


Figure 4. The size distribution and mean relative weight (Wr) by inch group of LMB collected in the spring 2015 from the Bayou Bienvenue Central Wetlands area. n=78.

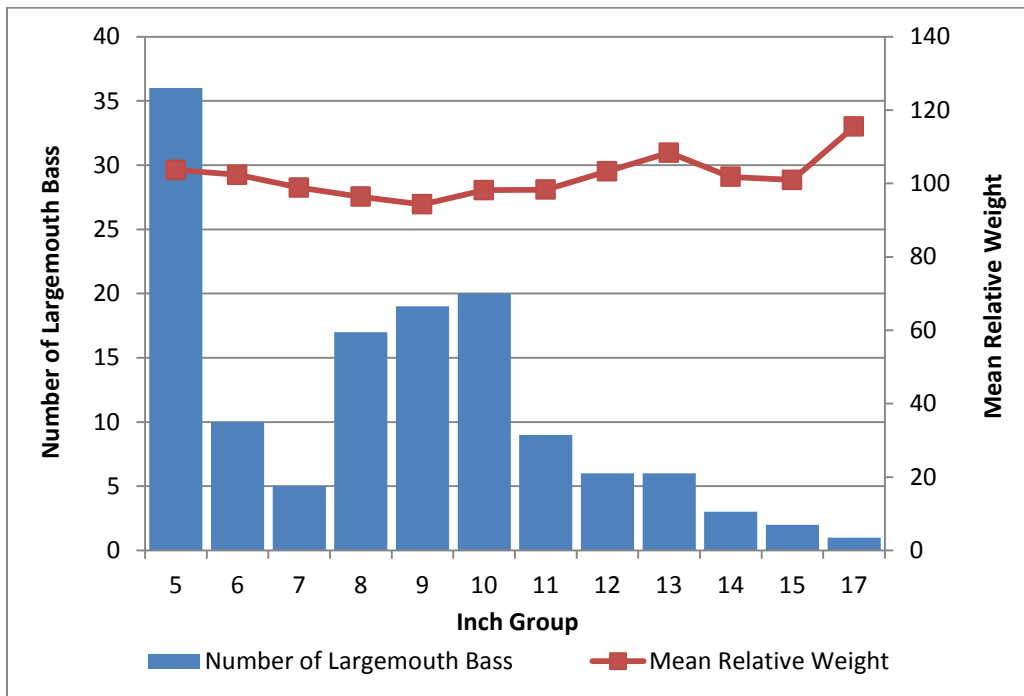


Figure 5. The size distribution and mean relative weight (Wr) by inch group of LMB collected in the fall 2015 from the Bayou Bienvenue Central Wetlands area. n=134.

Catch per unit effort (CPUE) is the term used to describe the number of fish collected during a given time period of sampling. For electrofishing samples, the standard CPUE time period is one hour and the unit is the number of fish captured. CPUE is an index of relative abundance for electrofishing results and is usually displayed as the number of fish captured per hour of sampling effort. CPUE for LMB collected in the spring and fall 1995-2015 has displayed a general downward trend (Figures 6 and 7). From 1995-2013, sampling was conducted at stations located in the Caernarvon outfall area which is affected by habitat loss. A more expansive sampling regime of the LPSB began in 2015 to capture a comprehensive data set across the entire sub-basin. CPUE of LMB by size class for samples collected during spring and fall electrofishing 1995-2015 are illustrated in Figures 8 and 9, respectively. Spring results continue the downward trend, but fall 2015 samples indicate a slightly higher CPUE for all size classes when compared to the fall 2013 results.



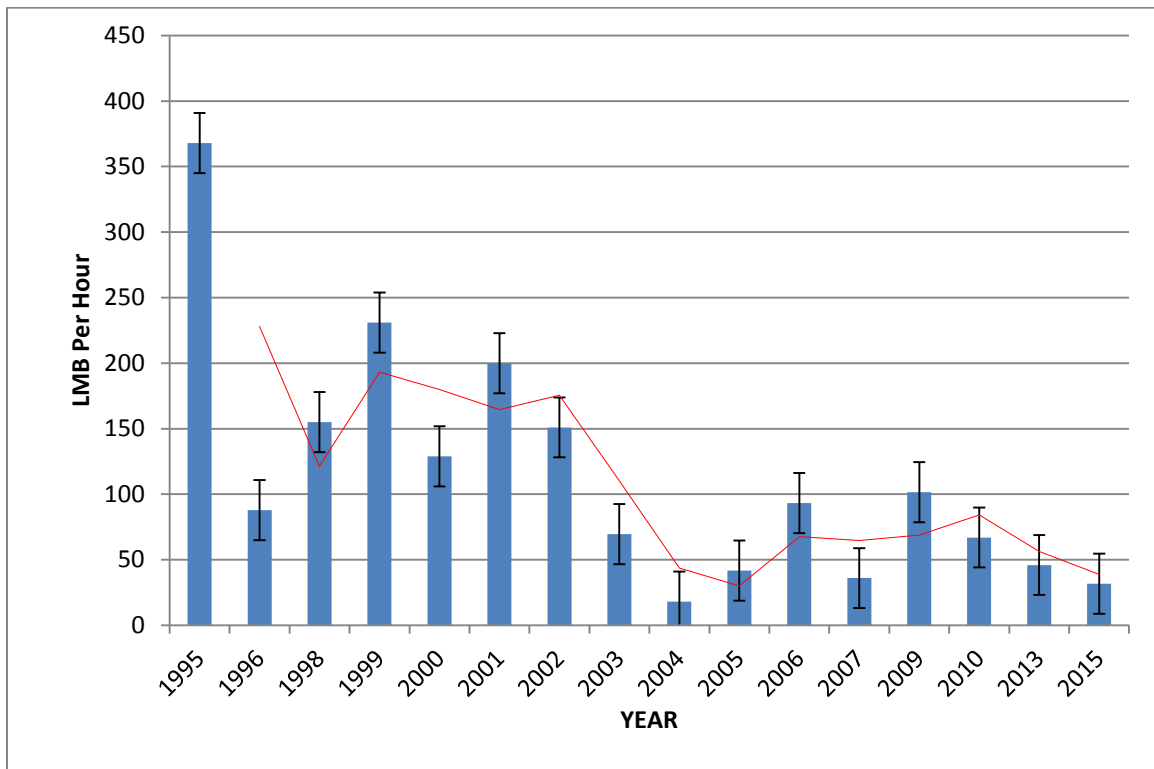


Figure 6. The mean CPUE (+ SE) in number per hour for LMB collected from the Caernarvon / Delacroix area during spring electrofishing from 1995 – 2015.

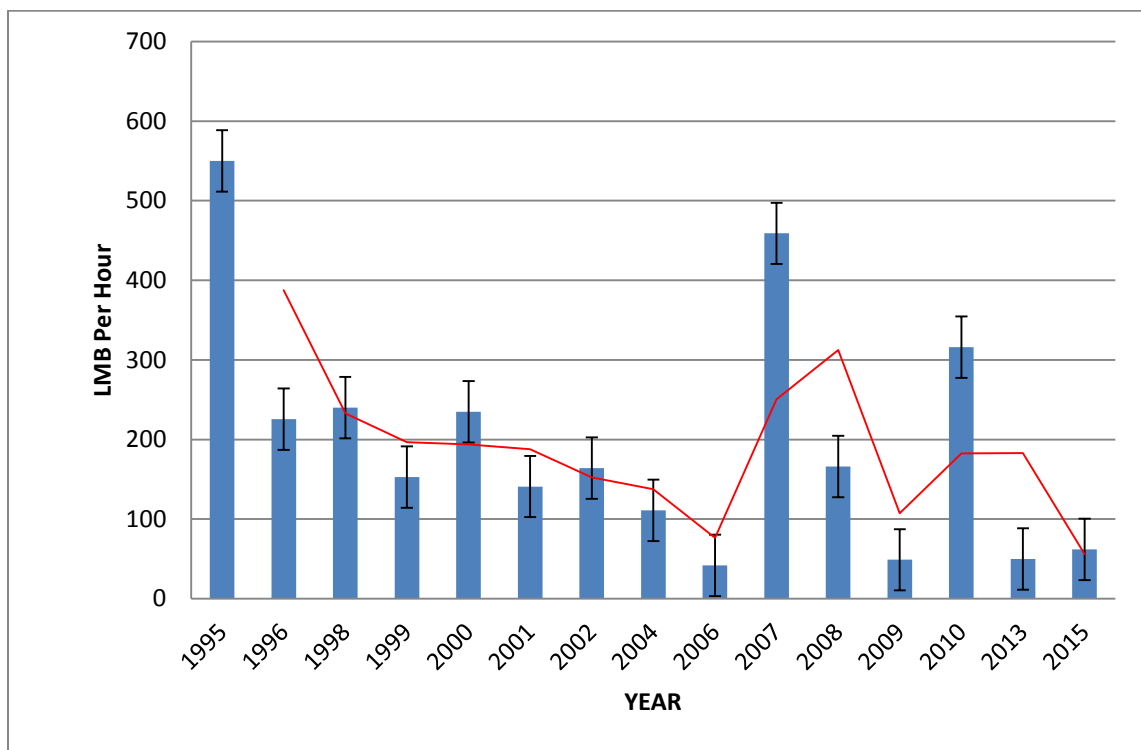


Figure 7. The mean CPUE (+ SE) in number per hour for LMB collected from the Caernarvon / Delacroix area during fall electrofishing in 1995 – 2015.

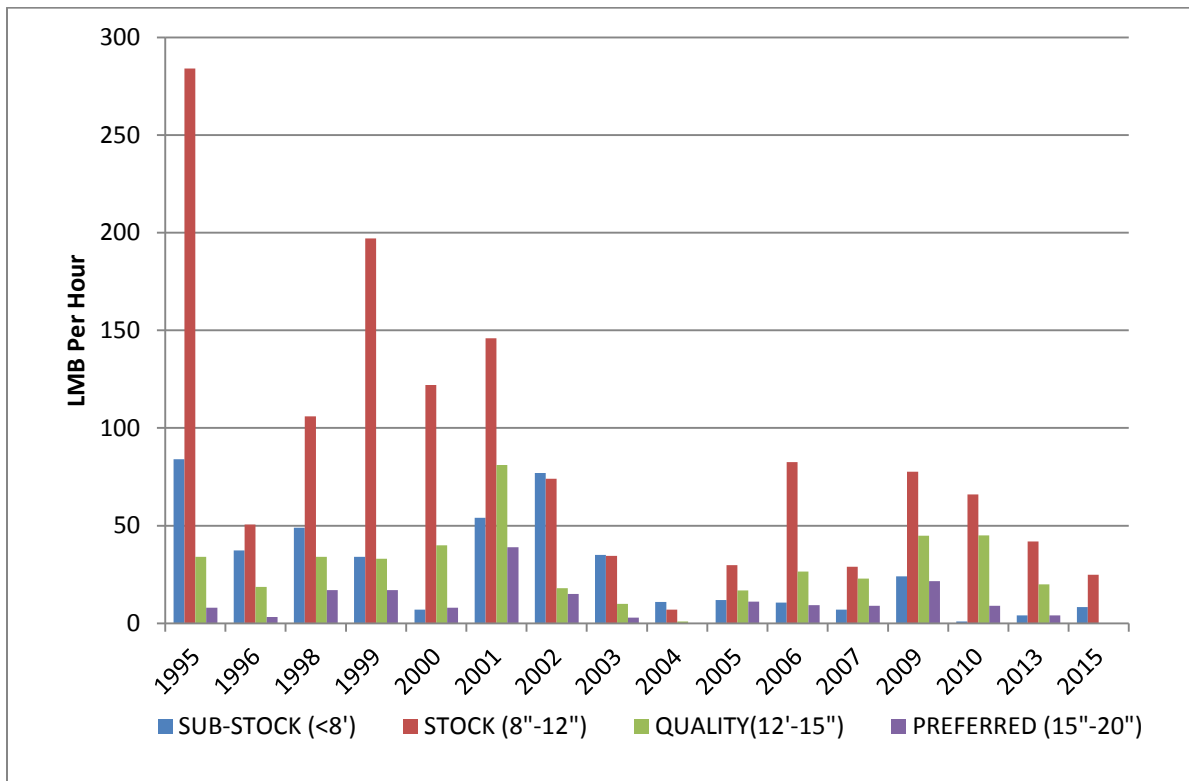


Figure 8. CPUE for LMB by size class collected during standardized spring electrofishing samples from 1995-2015 in the Caernarvon / Delacroix area.

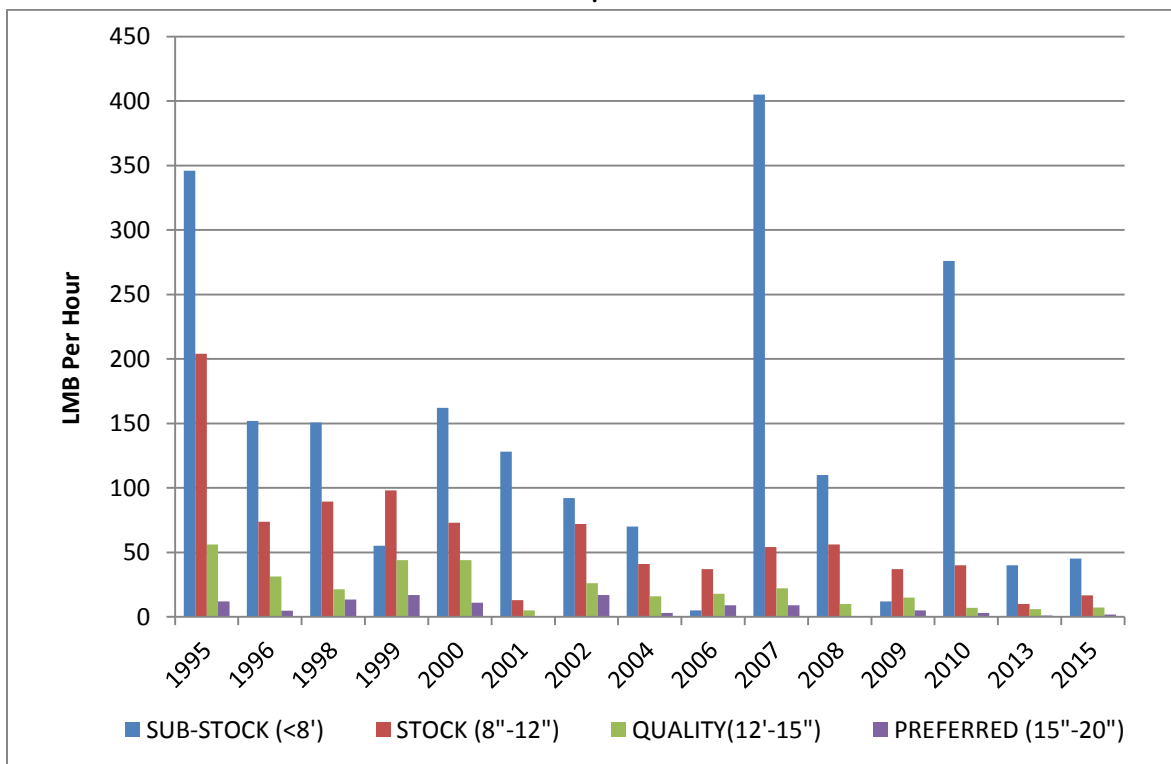


Figure 9. CPUE for LMB by size class collected during standardized fall electrofishing samples from 1995-2015 in the Caernarvon / Delacroix area.

### Size structure indices

Proportional stock density (PSD) and relative stock density (RSD) are indices used to numerically describe length-frequency data (Anderson and Neumann 1996).

Recent (2007-2013) PSDs and RSDs for preferred length fish (14-20 inches) for spring samples in the Caernarvon / Delacroix area were within the optimum range of 40-70 and 10-40, respectively, for a balanced largemouth bass population (Figure 8; Anderson and Neumann 1996). The 2015 spring samples indicate an unbalanced LMB population (Figure 10), while the fall samples indicate a balanced population (Figure 11). The LPSB is a dynamic ecosystem affected by freshwater diversions, accretion, and habitat alterations due to flood control efforts and landscape restoration. Intra annual seasonal variability may be a reflection of habitat variability found in the ecosystem.

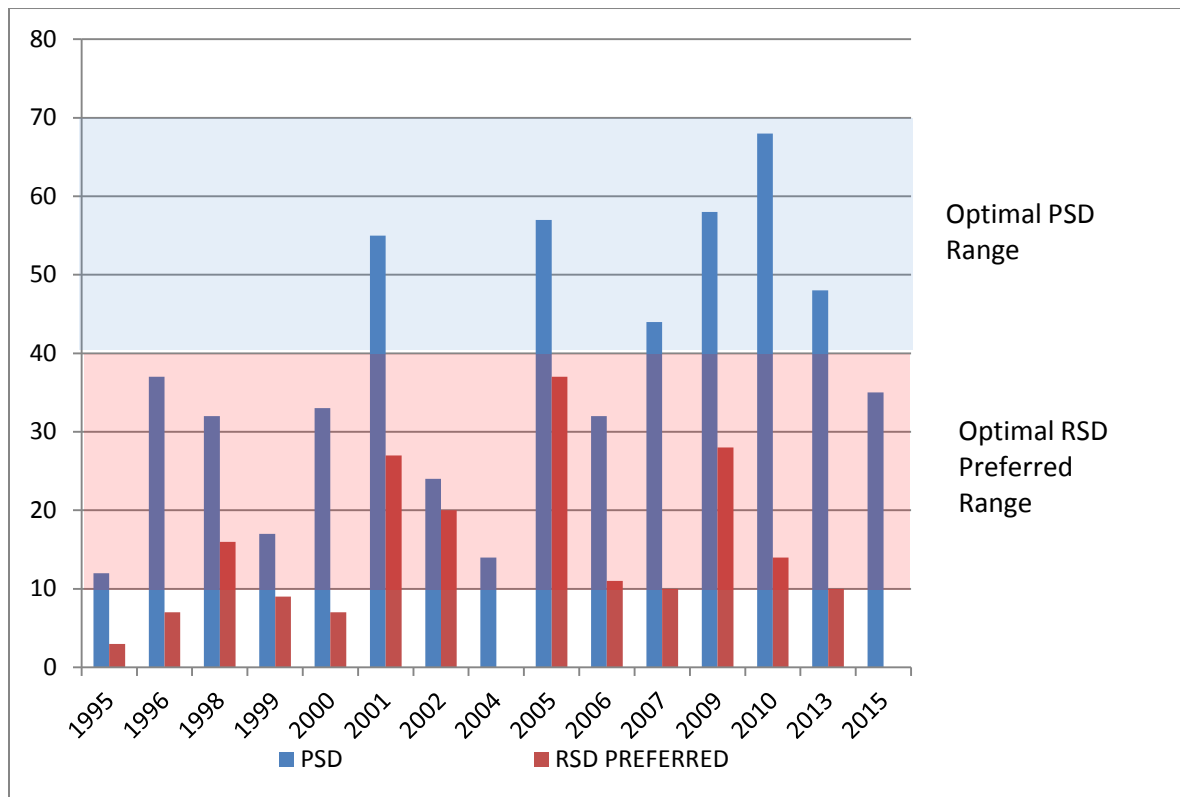


Figure 10. Proportional stock density and relative stock density (preferred) for LMB in the Caernarvon / Delacroix area, from spring electrofishing results, 1995 – 2015.

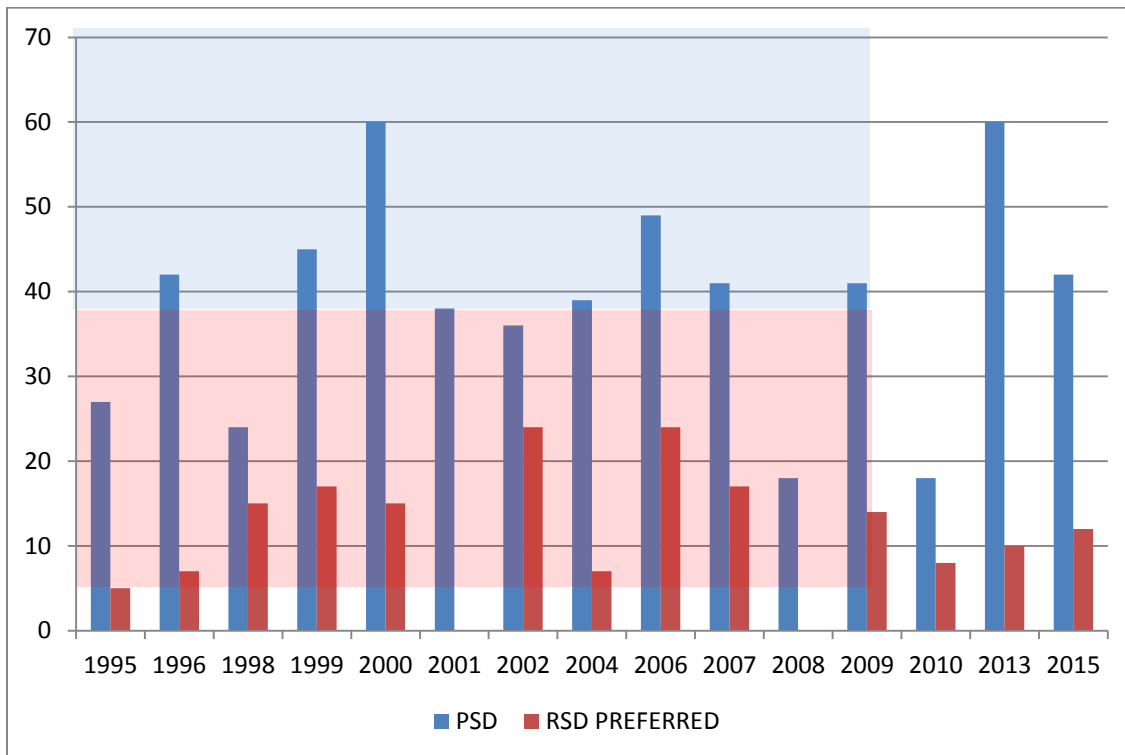


Figure 11. Proportional stock density and relative stock density (preferred) for LMB in the Caernarvon / Delacroix area, from fall electrofishing results, 1995 – 2015.

#### 2000-2002 Creel Survey

In response to angler requests for more protective regulations for largemouth bass in the Caernarvon area, a three year access point creel survey was initiated in 2000. The purpose of the survey was to collect data to describe public use of the largemouth bass fishery. The number of creel days ranged from 48-55 per year from 2000-2002 (Figure 12). The number of interviews conducted and the number of anglers interviewed ranged from 255-354 and 428-693, respectively from 2000-2002 (Figure 13).

The majority of angler caught bass were released in 2000, 2001, and 2002 (76, 83, and 85%, respectively; Figure 14). Only 31, 18, and 42 percent of harvested bass in 2000, 2001, and 2002, respectively, were < 12 inches TL. A 12 inch minimum length regulation would have protected only a small percentage of harvested fish. The application of a protected length range (slot limit) in this situation would have provided protection to for some bass from harvest. However, the existing high voluntary release rate would undermine any potential benefits. LDWF analysis of creel data determined that concerns of bass overharvest were unfounded and that more restrictive harvest regulations would provide no significant effect.

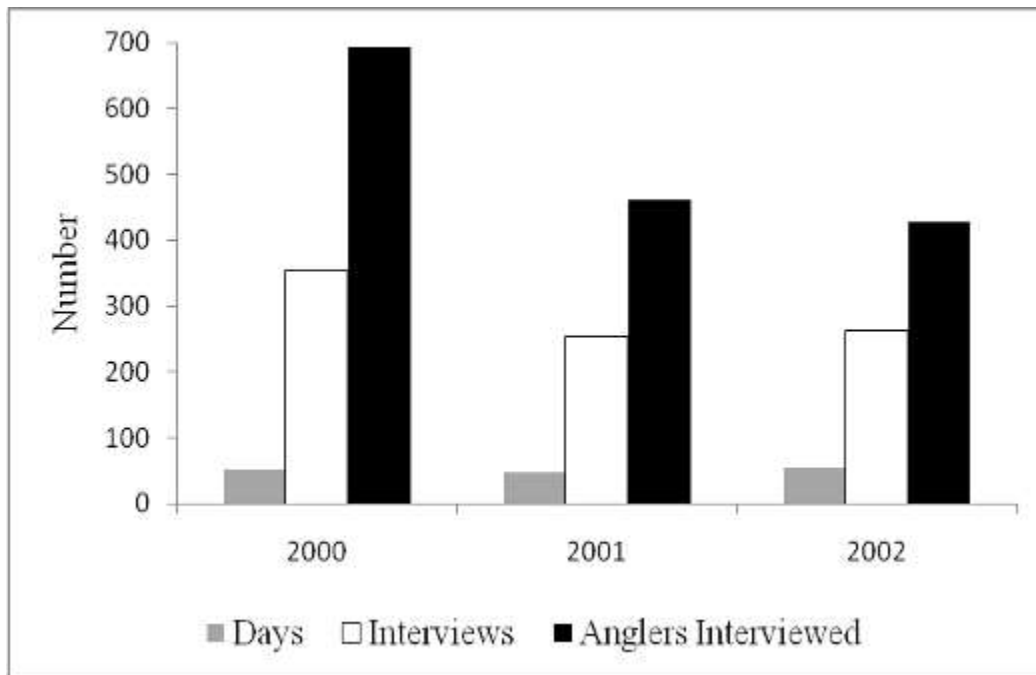


Figure 12. Number of creel days, interviews, and anglers interviewed during a three year (2000-2002) access point creel survey in the Caernarvon area.

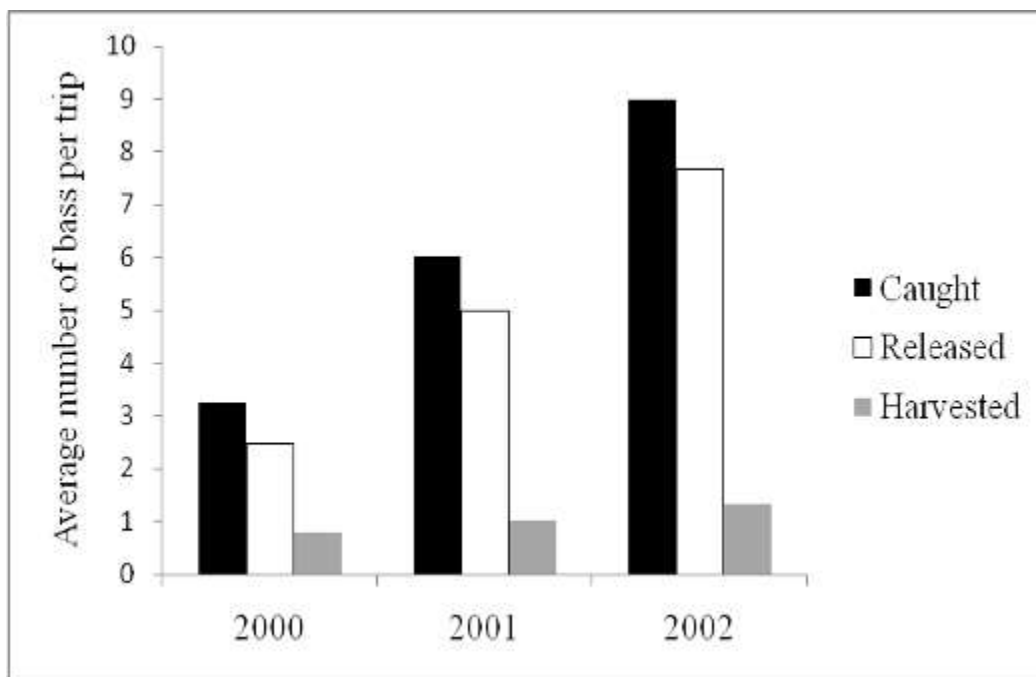


Figure 13. Average number of bass caught, released, and harvested per trip and reported by anglers during a three year (2000-2002) access point creel survey in the Caernarvon area.

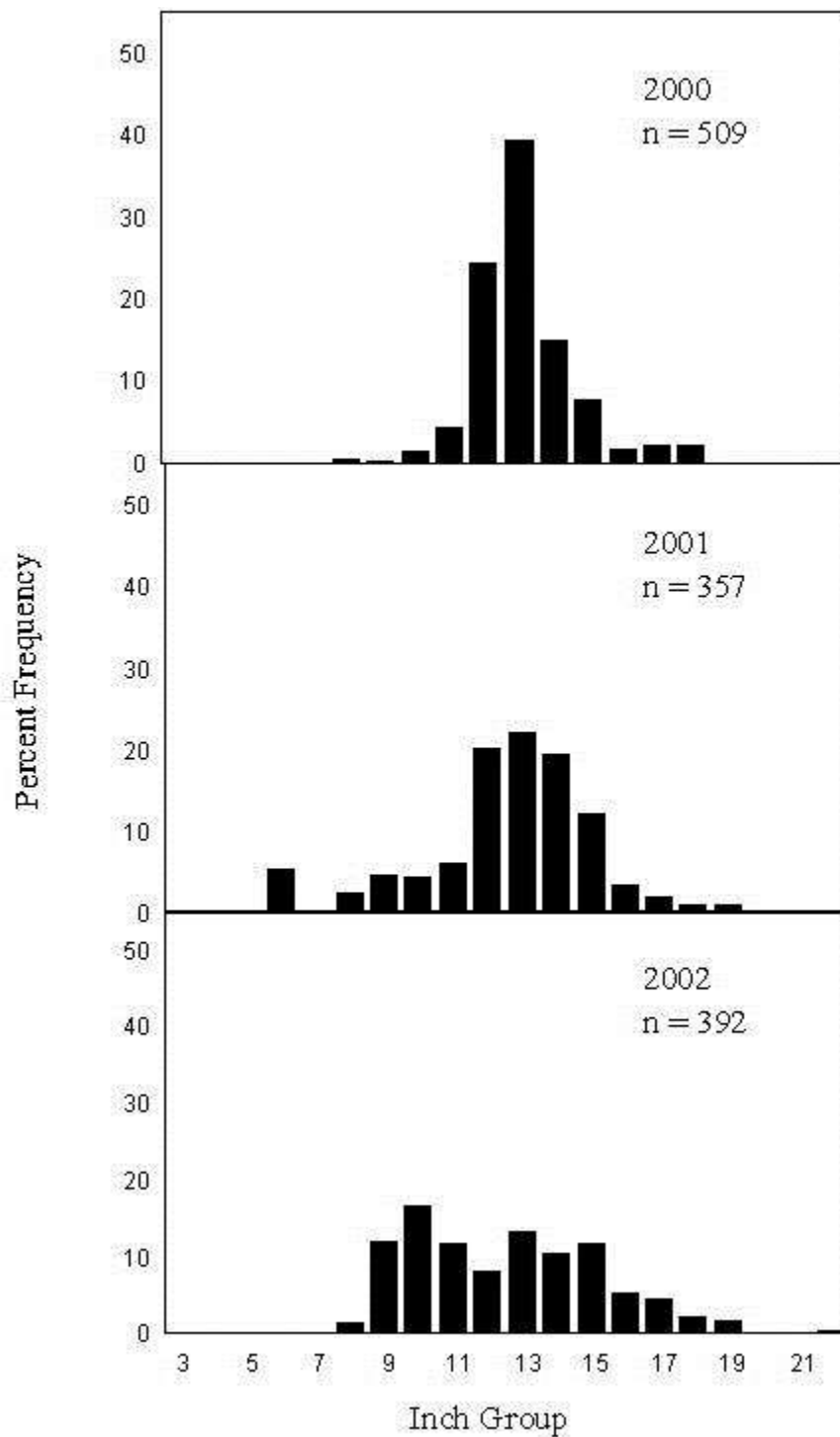


Figure 14. The size distribution (inch groups) for largemouth bass harvested by anglers and reported during a three year (2000-2002) access point creel survey in the Caernarvon area.

### Genetics

Genetic analyses have been conducted on a series of largemouth bass samples collected in the Caernarvon area (Table 1). Allozyme starch gel electrophoresis analyses were conducted at the Louisiana State University School of Renewable Natural Resources. Results of analyses determined that LDWF stocking efforts have not successfully incorporated Florida genetics into the Caernarvon largemouth bass population. Competition from the native bass population is considered to be the primary obstacle. LDWF sampling indicates strong native bass recruitment in response to the frequent and extensive fish kills that occur in the Caernarvon area. Competition from the resilient native bass population is suspected as a primary contributor to the poor success of Florida bass introductions.

Table 1. Composition of northern, Florida, and F<sub>x</sub> largemouth bass (intraspecific hybrids) collected during fall electrofishing samples. Included are size and number of Florida largemouth bass stocked in the Caernarvon area.

YEAR	SIZE	FLMB STOCKED	GENETIC SAMPLING RESULTS				
			N	% NLMB	% FLMB	% F <sub>x</sub>	TOTAL FLORIDA INFLUENCE
1996	Fingerlings	39,000					
1997	Fingerlings	55,235	75	80	2	18	20
1998	Fingerlings	243,603					
	Adults	43					
1999	Advanced Fry	300,000	100	88	0	12	12
	Fingerlings	260,956					
2000	Sac Fry	119,900	91	84	16	0	16
	Fingerlings	120,208					
2001	Phase II Fingerlings	10,010					
2002	Phase II Fingerlings	1,520	43	81	5	14	19
2003	Phase II Fingerlings	2,178					
	Adults	173					
2005	Phase II Fingerlings	14,710					
2006	Fingerlings	96,424					
	Phase II Fingerlings	2,025					
	Adults	92					
2007			100	82	1	17	18
2008	Phase II Fingerlings	1,200					

### Forage and Fish Assemblage

Forage abundance and availability is typically measured directly through LDWF fishery independent sampling (electrofishing and shoreline seine sampling) and indirectly through assessment of largemouth bass body condition (relative weight). Relative weight (Wr) is the ratio of a fish's weight to the weight of a "standard" fish of the same length. The index is

calculated by dividing the weight of a fish by the standard weight for its length, and multiplying the quotient by 100. Largemouth bass relative weights below 80 indicate a potential problem with forage availability. Values near 100 indicate robust body condition. Electrofishing samples are conducted in the fall to evaluate fish assemblages (Figure 15 and 16). Sunfishes (*Lepomis* spp.) comprise the majority of the vertebrate forage in both units. Invertebrates are also an important prey item.

#### Caernarvon / Delacroix

Relative weights of largemouth bass caught in the Caernarvon / Delacroix management unit (fall 2015) ranged between 98 and 108 (Figure 3).

#### Bayou Bienvenue Central Wetlands

The Bayou Bienvenue Central Wetlands LMB relative weight results for fall 2015 ranged between 94 and 117 (Figure 5).

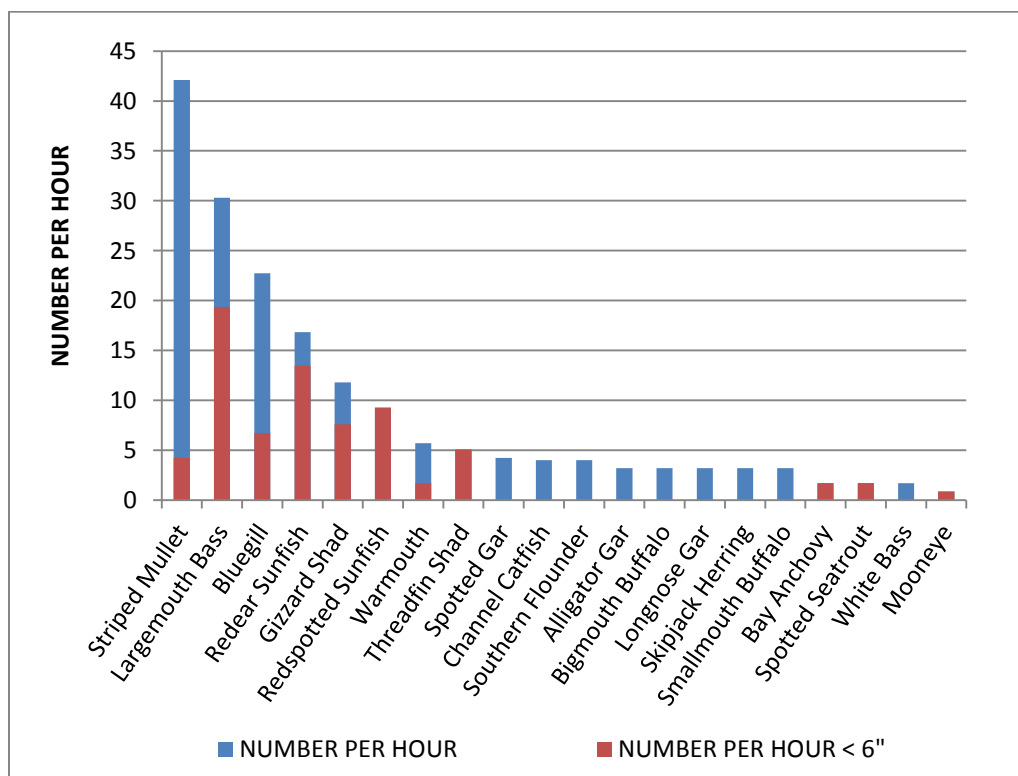


Figure 15. The CPUE of all fish species < 6" TL collected in standardized fall assemblage / forage electrofishing samples in the Caernarvon / Delacroix management unit in 2015.



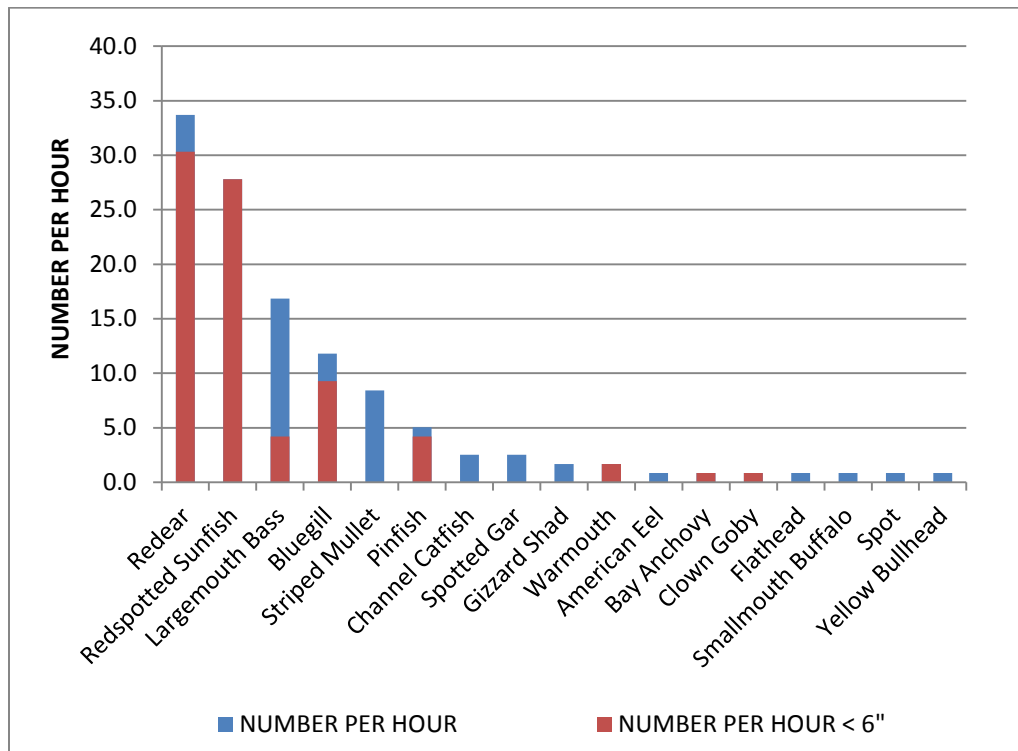


Figure 16. The CPUE of all fish species < 6" TL collected in standardized fall assemblage / forage electrofishing samples in the Bayou Bienvenue Central Wetlands management unit in 2015.

### *Crappie*

Crappies are only occasionally collected in Caernarvon fish population sampling and seldom observed in angler creel surveys for the area. Because crappies are such a minor component of the Caernarvon fish population, continuous monitoring and specific management for the species is not conducted.

### Commercial

According to trip ticket information submitted by commercial fisherman, commercial species of interest in the Caernarvon area include alligator gar, minnows, blue catfish, channel catfish, and gizzard shad (Table 2). Commercial landings are low and no cause for consideration of additional regulations.

Table 2. Commercial landings reported from the Caernarvon area from 2000-2015 at the non-confidential level ("0" indicates confidential landings and "." indicates no reported landings).

	YEAR															
SPECIES	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
Alligator Gar	13,964	11,477	0	0	0	0	0	.	.	0	.	0	0	.	0	0
Blue Catfish	0	0	.	0	.	.	.	.	.	.	0	.	0	.	0	0
Channel Catfish	0	.	.	.	.	0	.	.	.	0	0	.	.	.	.	0

Gizzard Shad	.	.	.	.	.	.	.	.	0	.	.	0	.	.	.	0
Minnows	1003	0	575	0	994	.	.	.	.	.	.	.	.	.	.	0

An evaluation of channel catfish population characteristics was conducted in Lake Des Allemands and Lake Maurepas from 1985-1987 (McElroy et al. 1990). Repeated requests from commercial fishermen to lower the commercial channel catfish minimum size limit regulation prompted the study. Fishermen suggested that the population was stunted and that additional harvest was needed. Results from the age, growth and maturity study indicated the channel catfish population in Lake Des Allemands reached sexual maturity at 360-379 mm TL which was similar to other commercially important stocks in Louisiana (Tilyou 1984). Lake Maurepas channel catfish matured at smaller sizes, but were not found to be short for their ages. The authors suggested neither population was stunted but may be effected by the physicochemical attributes of the mesohaline environment in which they live.

#### Species of Special Concern

The Gulf Sturgeon (*Acipenser oxyrinchus desotoi*) is a threatened species of concern in southeastern Louisiana. On January 25, 1994 a 42 lb. gulf sturgeon measuring 57 inches total length was caught, tagged and released in the southeastern part of Caernarvon near Delacroix.

## **HABITAT EVALUATION**

Habitat and hydrology are major components influencing fish populations. Periods of poor water quality can have an extended negative impact on the fishery. The Caernarvon outfall area has experienced habitat degradation from tropical activity and the effects of siltation. Other areas of the LPSB have experienced expansion of freshwater habitat.

#### *2010 Deepwater Horizon Oil Spill*

The 2010 *Deepwater Horizon* Oil Spill in the Gulf of Mexico was the nation's largest oil spill. The Lower Pontchartrain Sub-basin was affected by direct oiling and response activities. The investigation into the impacts of the Deepwater Horizon oil spill on natural resources including fisheries, aquatic vegetation, and wetlands is still ongoing.

#### Aquatic Vegetation

Aquatic vegetation is highly influenced by natural and anthropogenic alterations to the hydrology of the LPSB. An annual survey of aquatic vegetation is used to produce a type map and an estimate of current aquatic vegetation coverages. Beneficial submersed aquatic vegetation includes a mixture of coontail (*Ceratophyllum demersum*), water-milfoil (*Myriophyllum*) and fanwort (*Cabomba caroliniana*). Problematic vegetation is primarily floating plants consisting of water hyacinth (*Eichhornia crassipes*), giant salvinia (*Salvinia molesta*) and duckweed (*Lemna minor*). Emergent plants such as alligator weed (*Alternanthera philoxeroides*), water primrose (*Ludwigia* spp.) are a smaller portion of the LPSB's overall aquatic vegetation biomass.

*Caernarvon / Delacroix*

### Problem Vegetation

Salinity spikes, such as those that resulted from Hurricanes Katrina, Gustav, Ike and Isaac have limited the spread of giant salvinia (*Salvinia molesta*) and water hyacinth (*Eichhornia crassipes*) in the Caernarvon / Delacroix area. LDWF spray crews treated 108 acres of water hyacinth around the Caernarvon outfall area in 2012. No herbicide applications were necessary in 2013. In 2014, annual vegetation surveys indicated a resurgent population of water hyacinth with an estimated 200 acres in the area. In 2015, 110 acres of water hyacinth and 110 acres of giant salvinia were treated. Water hyacinth is treated with glyphosate (0.75 gal/acre) and a 90:10 nonionic surfactant (0.25 gal/acre) from March 15 to September 15 and 2,4-D (0.5 gal/acre) with a 90:10 nonionic surfactant (1 pint/acre) from September 16 to March 14 in those areas that lie within St. Bernard Parish. In those areas that lie within Plaquemines Parish, water hyacinth is treated with glyphosate (0.75 gal/acre)/90:10 nonionic surfactant (0.25 gal/acre). The use of 2,4-D is prohibited in Plaquemines Parish. Giant salvinia is treated with a mixture of glyphosate (0.75 gal/acre)/diquat (0.25 gal/acre)/Turbulence (0.25 gal/acre) from April 1 - October 31 and diquat (0.75 gal/acre)/90:10 nonionic surfactant (0.25 gal/acre) from November 1 – March 31.

### Beneficial Vegetation

Beneficial submersed aquatic vegetation has increased in some areas, but is influenced by changing salinity regimes and may be ephemeral. The operation of the Caernarvon freshwater diversion and influences from Mardi Grass Pass greatly contribute to these shifting salinity regimes. Coontail (*Ceratophyllum demersum*), a beneficial submerged aquatic plant, is the dominant species ranging from 20% coverage in Lake Lery to 80% coverage in Spanish Lake. It provides a microhabitat for small and juvenile fish as well as invertebrate species.

### Bayou Bienvenue Central Wetlands

#### Problem Vegetation

Approximately 800 acres of giant salvinia were documented in the marsh east of Bayou Bienvenue to the Violet canal during a November 2013 aerial survey. Giant salvinia still persist in these areas; the population will fluctuate seasonally with its peaks in August and September. It is control to an extent by rising salinities in the fall. Giant salvinia weevils (*Cyrtobagous salviniae*) have been introduced and herbicide applications will be conducted in the area as needed. Giant salvinia is treated with a mixture of glyphosate (0.75 gal/acre)/diquat (0.25 gal/acre)/Turbulence (0.25 gal/acre) from April 1 - October 31 and diquat (0.75 gal/acre)/ 90:10 nonionic surfactant (0.25 gal/acre) from November 1 – March 31.

## **CONDITION IMBALANCE / PROBLEM**

1. There is an abundance of organic material in this area. Organic material is not ideal for optimal largemouth bass spawning success.
2. Several popular fishing canals were silted in as a result of Hurricanes Katrina, Gustav, Ike and Isaac. Accretion due to the freshwater diversion and siphons also contributes to the siltation of these canals and habitat alterations.

3. Fine scale problems affecting freshwater fisheries in the LPSB include eutrophication, excessive turbidity, predation, habitat loss, invasive species and storm related fish kills. Many of these problems can be exacerbated by the operation of the diversion. Exotic aquatic fauna such as silver carp (*Hypophthalmichthys molitrix*) and nuisance aquatic vegetation such as giant salvinia (*Salvinia molesta*) are associated with connections to the Mississippi river. Also water column light attenuation issues resulting from nutrient overloading and total suspended solids, which may affect submersed aquatic vegetation (fish habitat), can be connected to the operation of freshwater diversions. Understanding the relationship between diversion operations and fisheries is paramount.

### **CORRECTIVE ACTION NEEDED**

1. A self-sustained population of giant salvinia weevils (*Cyrtobagous salviniae*) should be established to serve as a biological control measure.

## RECOMMENDATIONS

There are numerous stakeholders in the Caernarvon Freshwater Diversion Outfall Area and the entire LPSB that are impacted by the operations of the diversion, siphons and flood control gates. It is difficult to manage the diversion and satisfy all stakeholders. The Caernarvon Freshwater Diversion Project (CFDP) was authorized to enhance emergent marsh vegetation growth, reduce marsh loss, and increase the productivity of significant commercial and recreational fish and wildlife (LDNR 2003). The operational plan for the CFDP is subject to adaptive management practices and is set annually. The actual amount of diverted flow depends on a detailed operational plan that is set by the Caernarvon Interagency Advisory Committee every year and river stages in the Mississippi River. The current 2016 Caernarvon operations are based on the monthly salinity range at the 15 ppt line from December through May and based on the monthly salinity range at the 5 ppt line from June through November (see Caernarvon Freshwater Diversion Operational Plan 2016 – **APPENDIX I**).

The following are recommended monitoring practices to closely observe changes in fisheries and aquatic habitat in response to alterations in the operational practices of the CFDP.

1. Standard sampling:
  - a. Take an adapted approach to standardize sampling site selection, which includes habitat evaluation and water chemistry parameters. Continue the more expansive sampling regime of the LPSB that began in 2015 to capture a comprehensive data set across the entire sub-basin.
    - i. Review sample sites biennially and make necessary adjustments.
    - ii. Add sites as needed to reduce standard error.
  - b. Continue the 225 second fish assemblage sample in the fall at every sample station to evaluate changes in relative abundances.
  - c. In 2017, include portions of the Middle Pontchartrain Sub-Basin, including Pass Manchac, Ruddock, Bayou Trepagnier, and La Branche Wetlands to the sampling regime.
2. Freshwater diversions and siphons are a large component of the basin's hydrology. Understanding their effects on water quality is important. Monitoring parameters such as turbidity and chlorophyll *a* would aid in quantifying thresholds in which submersed aquatic vegetation is productive, therefore increasing our ability to define suitable aquatic habitat. Adding these parameters to existing constant recording devices or acquiring and locating devices owned and operated by LDWF is an alternative. Also, several marsh and shoreline restoration projects are in progress in areas around Lake Lery. In 2017 begin a monthly water quality regime in Lake Lery to monitor their effects.

Recommendations for aquatic weed management in the area include:

1. Annual boat surveys will be conducted in the spring to produce a comprehensive site map of the LPSB and an aerial survey will be conducted in the fall to estimate total acreage of aquatic vegetation.
2. When giant salvinia manifests as a problem in the area, giant salvinia weevils should be introduced as a biological control method. Giant and/or common salvinia will be treated with foliar applications of glyphosate (0.75 gal/acre) and diquat (0.25 gal/acre) with Turbulence (0.25 gal/acre) surfactant from April 1 - October 31. Giant and/or common

salvinia will be treated with foliar applications of diquat (0.75 gal/acre) and a non-ionic surfactant (0.25 gal/acre) from November 1 – March 31.

3. Water hyacinth should be treated with 2,4-D at a rate of 0.5 gallons per acre in those areas that lie within St. Bernard Parish. In those areas that lie within Plaquemines Parish, water hyacinth should be treated with glyphosate (0.75 gal/acre)/ 90:10 nonionic surfactant (0.25 gal/acre). The use of 2,4-D is prohibited in Plaquemines Parish.

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## APPENDIX I

### CAERNARVON OPERATIONAL PLAN 2016

From December through May, the intent is to operate the diversion to maintain the seasonal average salinity at the 15 ppt isohaline line illustrated in the map below. A salinity gauge has not existed at the 15 ppt isohaline line, though one was installed closer to the line in May 2014 (USGS gauge #073745275, Black Bay near Stone Island). Salinities at the Stone Island gauge will continue to be monitored in 2016, though December-May operations will be primarily based on data from the Black Bay gauge specified by the map (Figure 1) and graph below (Figure 2). From June through November, Caernarvon operations will be based on the monthly salinity range at the 5 ppt line specified by the map (Figure 1) and graph (Figure 3) below, utilizing the Crooked Bayou gauge. The structure will be operated when the 14-day moving average salinity is within or above the long term data range for the gauge(s) in use. When the moving average drops below the low trigger (the greater of the long term average minus 1 SD or 5ppt) the diversion operations will be ceased until the moving average re-enters the operational range\*. Operational settings are not to exceed 7500 cfs.

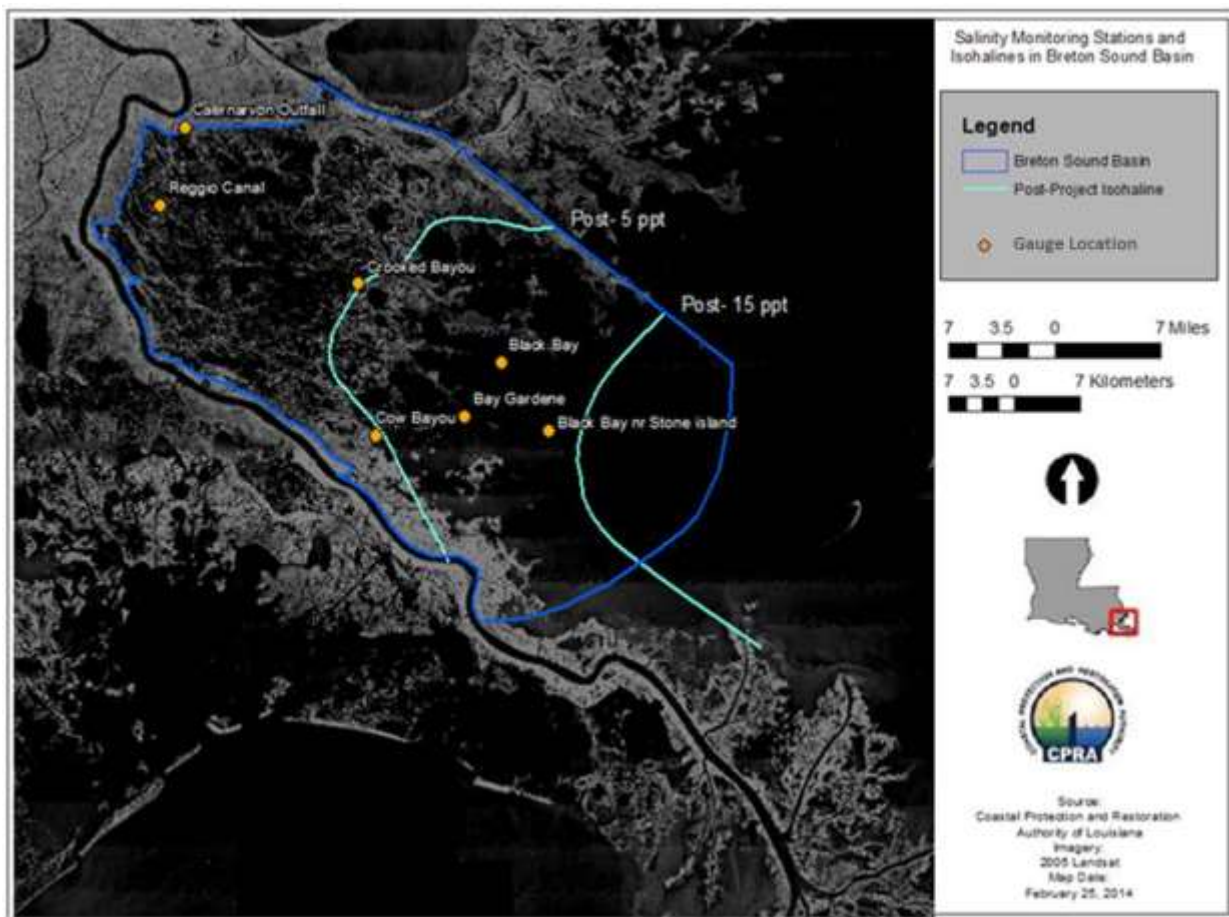


Figure 1. Map of salinity gauges and isohaline lines in Breton Sound basin to be used for guidance and operation of the Caernarvon Freshwater Diversion.

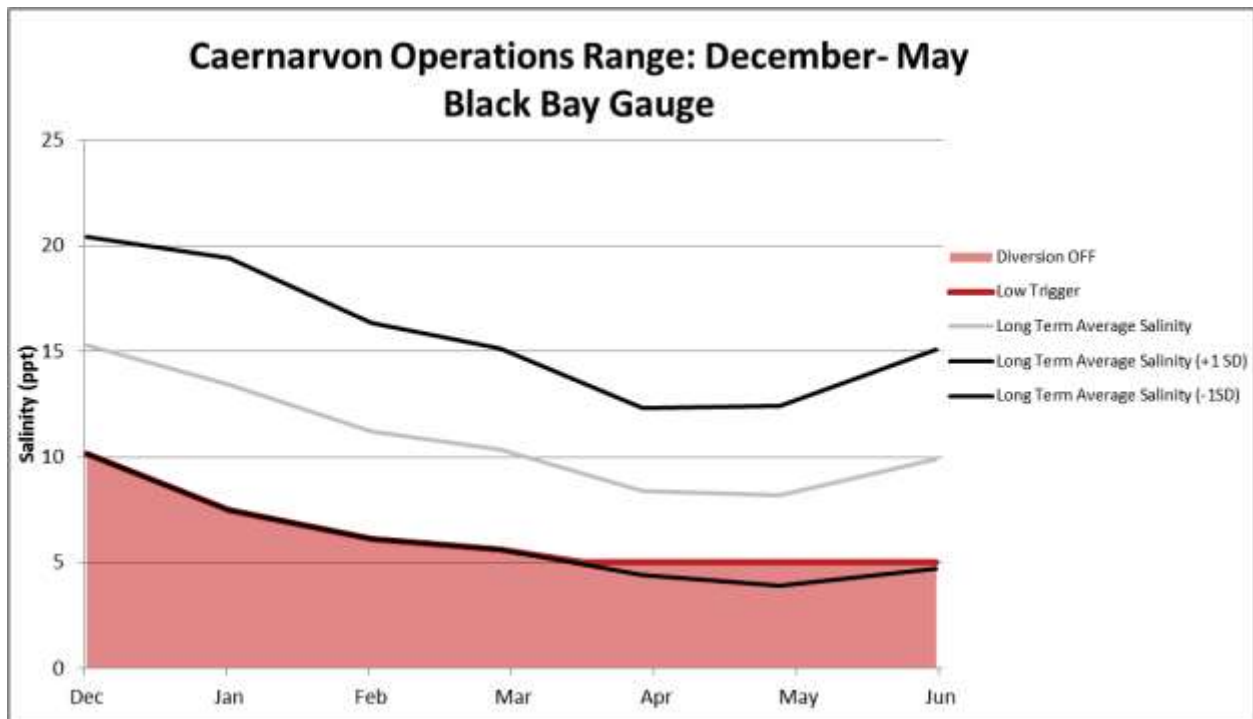


Figure 2. Long term average (+1 standard deviation) salinities from the Black Bay Gauge (USGS site 07374526). From December through May the Caernarvon Freshwater Diversion structure maybe operated when the 14-day moving average salinity is within or above the data range. Operations will cease if the moving average drops below the low trigger.\*

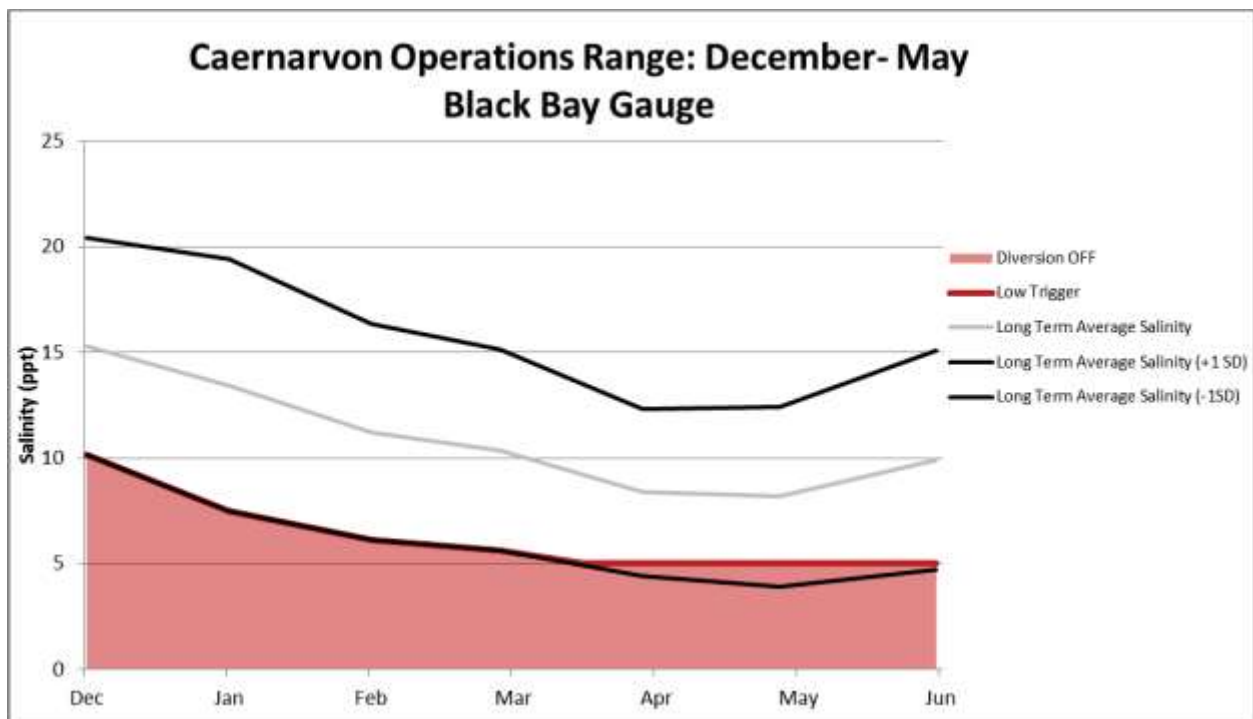


Figure 3. Long term average (+1 standard deviation) salinities from the Crooked Bayou (USGS site 073745257) and Cow Bayou (USGS site 073745258) gauges. From June through November the Caernarvon Freshwater Diversion structure maybe operated when the 14-day moving average salinity is within or above the data range. Operations will cease if the moving average drops below 5ppt.\*



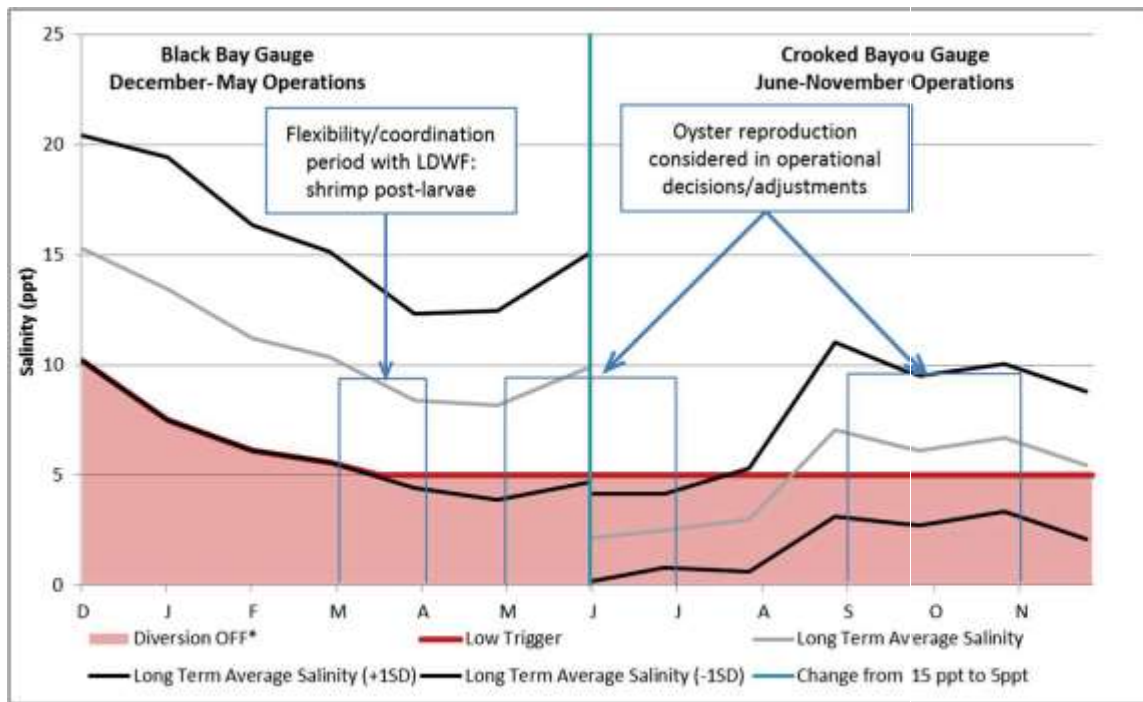


Figure 4. The Long term average (+1 standard deviation) salinities recorded at the Black Bay Gauge (USGS site 07374526). from December through May, and the Crooked Bayou (USGS site 073745257) gauge from June through November.

The Caernarvon Freshwater Diversion structure maybe operated when the 14-day moving average salinity is within or above the data range. Operations will cease if the moving average drops below the low trigger. Blue boxes indicate timeframes of species-specific considerations. \*

\*Discharges may deviate from operational plan as outlined below:

- Emergency, maintenance and local parish situations will be evaluated on a case-by-case basis to determine operational needs. The CIAC shall be notified if operations outside of the plan are required.

- Structure may be operated for public relations and/or educational purposes, though output is not to exceed 5000 cfs for duration of no longer than 2 hours.

Coordination with LDWF during post-larval brown shrimp migration period and oyster reproductive seasons to assist in operational decisions/adjustments to maximize benefits.